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SPECIFICATION FOR NIOBIUM (COLUMBIUM)

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SPECIFICATION FOR NIOBIUM (COLUMBIUM)

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 January 1976, after the draft finalized by the Ferro Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 Most of the niobium in commerce is consumed in the form of ferroniobium. A relatively small volume of niobium in pure and alloyed form goes for special purpose application. Niobium in the pure and unalloyed form, because of its economic advantage over tungsten and tantalum, is used for the fabrication of anodes, cathodes and grids in vacuum tubes. For application in this field, metal in the purity range obtainable from electron beam melting of the virgin metal (produced by one of the methods indicated in **0.2.2**) has been considered appropriate. For most of the other applications, niobium finds use in the alloyed form. A family of super alloys with niobium as the base constituent have found application in rocket components, gas turbines and jets. In nuclear power reactors, a Zr-2·5 percent Nb alloy is emerging as a superior structural material. In superconduction technology, niobium base alloys (Nb_3Sn, Nb-Ti and Nb-Zr) are well established.

0.2.1 For such applications where niobium is used principally in alloyed form, the purity and the forms in which the metal is required may vary widely. While the purity of the electron beam melted metal could be ideal for most purposes if cost were no consideration, less costly virgin metal in the as-extracted or vacuum-processed form may be acceptable for specific application.

0.2.2 The reduction of niobium compounds to metal may be effected by any one of the following techniques:

a) Fusion electrolysis of double fluoride of niobium,
b) Sodium reduction of double fluoride of niobium,
c) Hydrogen reduction of niobium halides,
d) Magnesium reduction of niobium halides,
e) Carbothermic reduction of niobium oxide, and
f) Metallothermic reduction of niobium oxide.

0.3 There is no Indian Standard at present for determination of impurities in niobium. The method of analysis, therefore, would have to be agreed between the purchaser and the manufacturer. It may, however, be mentioned for guidance that iron, nitrogen, molybdenum and tungsten may be analysed by photometric methods, carbon by conductometric methods, oxygen by vacuum fusion analysis and the rest of the impurities by spectroscopy.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers niobium (columbium), both as primary metal and in consolidated ingot form. The primary metal can be in the form of powder, beads or sponge as produced in the extraction step. The ingot metal can be arc melted, electron beam melted or as consolidated by powder metallurgy.

2. GRADES

2.1 Niobium metal shall be of two grades, namely, Reactor Grade and Commercial Grade.

3. SUPPLY OF MATERIAL

3.1 General Requirements — General requirements relating to the supply of niobium (columbium) shall conform to IS : 1387-1967†.

3.2 The material shall be supplied in a form as mutually agreed to between the purchaser and the manufacturer.

4. CHEMICAL COMPOSITION

4.1 The chemical composition of the material shall be as given in Table 1.

4.1.1 Till an Indian Standard on methods of chemical analysis is published, the method of analysis shall be as agreed between the purchaser and the manufacturer (*see* **0.3**).

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*Rules for rounding off numerical values (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

TABLE 1 CHEMICAL COMPOSITION OF NIOBIUM (COLUMBIUM)

(*Clause* 4.1)

ELEMENT	REACTOR GRADE		COMMERCIAL GRADE	
	Ingot	Primary Metal	Ingot	Primary Metal
(1)	(2)	(3)	(4)	(5)
	ppm, *Max*	ppm, *Max*	ppm, *Max*	ppm, *Max*
C	100	*	500	*
N	300	*	400	*
O	300	*	800	*
H	20	*	50	*
Cl	300	—	—	—
Al	75	100	500	500
B	2	2	—	—
Ca	100	100	—	500
Cd	5	5	—	—
Co	30	30	—	—
Cr	100	100	500	500
Cu	100	100	—	—
Fe	500	500	500	500
Hf	100	100	—	—
Li	10	10	—	—
Mg	50	50	—	—
Mn	100	100	500	500
Mo	500	500	500	500
Na	100	100	—	500
Ni	200	200	500	500
Pb	50	50	—	—
Si	300	300	500	500
Sn	200	200	500	500
Ta	500 to 1 000*	500 to 1 000*	2 000	2 000
Ti	500	500	500	500
U	2	2	—	—
V	200	200	500	500
W	500	500	500	500
Zn	50	50	—	—
Zr	500	500	1 000	1 000
Niobium by difference (*Min*), percent	99·6	99·6	99·2	99·4

*As agreed by customer.

5. HARDNESS

5.1 In the case of primary metal inert atmosphere arc-melted buttons, the hardness of representative 100 g sample shall not exceed 150 *BHN*.

6. SIZE

6.1 As agreed to between the purchaser and the manufacturer.

7. PACKING

7.1 The material shall be supplied packed in suitable containers, in quantities mutually agreed to between the purchaser and the manufacturer.

8. MARKING

8.1 The material shall be marked with the following details:

a) Manufacturer's name or trade-mark, and
b) Grade.

8.1.1 The material may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9. SAMPLING

9.1 Representative samples shall be drawn according to the scheme of sampling given in 'Indian Standard method for sampling of ferro-alloys' (*under preparation*).

NOTE — Till this standard is published, the samples shall be drawn as agreed to between the purchaser and the manufacturer.

INDIAN STANDARDS
ON
FERRO ALLOYS

IS:	
1110-1969	Ferrosilicon (*second revision*)
1111-1964	Spiegeleisen (*revised*)
1170-1967	Ferrochromium (*first revision*)
1171-1973	Ferromanganese (*second revision*)
1466-1973	Ferrovanadium (*second revision*)
1467-1972	Ferrotungsten (*second revision*)
1468-1968	Ferrotitanium (*first revision*)
1469-1970	Ferromolybdenum (*second revision*)
1470-1969	Silicomanganese (*first revision*)
1471-1973	Ferrophosphorus (*first revision*)
2021-1973	Metallic manganese (*second revision*)
2022-1972	Calcium silicon (*first revision*)
2023-1973	Metallic chromium (*first revision*)
2024-1970	Silico-chromium (*first revision*)
2301-1963	Metallic silicon
2391-1970	Foundry nickel (*first revision*)
2782-1964	Primary nickel
3011-1973	Ferro zirconium (*first revision*)
3012-1965	Chrome manganese
3013-1972	Ferroboron (*first revision*)
3014-1973	Ferroniobium (ferrocolumbium) (*first revision*)
4182-1967	Misch metal
4409-1973	Ferronickel (*first revision*)
5632-1970	Wolframite concentrate
5633-1973	Vanadium pentoxide (*first revision*)
5634-1970	Molybdenum oxide (technical)
7148-1973	Ferro alloy for welding industry

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